

Quality Standards



Quality Standards for the use of personal FM systems

Promoting easier listening for deaf children

Our vision is of a
world without barriers
for every deaf child.

Acknowledgements

This document has been written by the UK Children's FM Working Group whose members are:

Gwen Carr, MRC Hearing and Communication Group, Manchester
Paul Doherty, Telford & Wrekin Sensory Inclusion Service
David Evans, Connevans
Brian Gale, NDCS
Paul Harris, Ewing Foundation
Ken Higgins, Ewing Foundation
Jeremy Hine, Oticon
Mary Hostler, Manchester University
Tony Murphy, Phonak
Carina Newman, Telford & Wrekin Sensory Inclusion Service
Roz Pither, Somerset Sensory, Physical and Medical Support Service
Elizabeth Reed-Beadle, BATOD
Sharon Robb, Oticon
Joyce Sewell-Rutter, Ewing Foundation
Panos Stavropoulos, Cochlear UK
Yvonne Tysoe, NDCS
Richard Vaughan, Connevans
Michael Wassell, P.C. Werth
Stuart Whyte, BATOD
Elizabeth Wood, South of England Cochlear Implant Centre



With thanks to:

Advanced Bionics
Cochlear UK
Stevie Mayhook, Ewing Foundation
Medel

Special thanks to John Bamford, Ellis Llwyd Jones Professor of Audiology and Deaf Education, University of Manchester.

The National Deaf Children's Society (NDCS)

NDCS is the national charity dedicated to creating a world without barriers for deaf children and young people.

We represent the interests and campaign for the rights of all deaf children and young people from birth until they reach independence.

NDCS believes that the family is the most important influence on a deaf child's development. NDCS supports the deaf child through the family as well as directly supporting deaf children and young people themselves.

Contents

Foreword	3
Notes to readers	4
Introduction	5
Candidacy for receiving a personal FM system	7
Fitting and setting up of personal FM systems	8
Management and use of personal FM systems	10
Evaluation of personal FM systems for individual children	12
Use of personal FM systems with soundfield systems	13
Conclusion	14
References	15
Further information	19
Glossary of terms	21

Foreword

All those with any degree of hearing loss, which means most of us in due course, will know that listening in any environment in which there is some degree of background noise or reverberation is difficult. It requires more effort and is therefore more tiring, leaves fewer cognitive resources available for rehearsing, recalling or otherwise manipulating the signal for optimal meaningfulness, and results in more errors of perception. For children and young adults with a hearing loss this can be particularly compromising to their progress in language acquisition and educational achievement since classrooms and school environments are necessarily less than optimal in their acoustic properties.

It has been known for many years that personal FM systems, if properly set up, represent undoubtedly the best method of improving the 'signal-to-noise' ratio for a listener. It is regrettable therefore that their funding and provision for pre-school and school age children and young people in the UK has remained patchy and inconsistent, despite efforts from RNID and NDCS in the 1980s through to the MCHAS recommendations in 2003.

The challenge of personal FM systems is more than ever one which must now be met. The advent of Digital Signal Processing hearing aids, recent disability legislation, and the *Every Child Matters* initiative point up the imperative to improve the funding, provision and management of personal FM systems for deaf children and young people. It is in this context that the development of these *Quality Standards for the Use of Personal FM Systems* and the detailed supporting Good Practice Guide is so very timely. They provide essential evidence-based material to help commissioners, teachers, audiologists, local authorities, and government departments to make sure, at last, that our deaf children and young people have properly fitted and well managed devices to enable easier and better hearing, and hence better educational and cognitive functioning.

John Bamford

Ellis Llwyd Jones Professor of Audiology and Deaf Education
University of Manchester

February 2008

Notes to readers

This document comprises two complementary parts:

- 1) A set of Quality Standards relating to the use of personal frequency modulated (FM) systems.
- 2) A Good Practice Guide (GPG), containing practical information and strategies to achieve these Quality Standards. This can be found on the CD attached to the inside front cover of the printed edition of this document or at www.ndcs.org.uk

Any recommendations from this document should only be implemented after full consultation with parents.

Terminology

‘Personal FM system’ is used throughout this document, rather than the synonyms ‘radio aid’ and ‘radio hearing aid’ which were once commonly used in the UK.

‘Sound enhancement systems’ are designed to benefit all children in a classroom, and are therefore distinct from the personal FM systems under discussion. The terms ‘soundfield systems’ or ‘soundfield FM systems’ are used when considering products that employ FM technology as opposed to an infra red or other transmission system. Soundfield systems are considered in this document only in relation to their use in conjunction with personal FM systems and the relative benefits of the different technologies. The authors have not attempted to provide comprehensive documentation regarding the use of soundfield systems.

The term ‘deaf’ is used to cover all types and levels of hearing loss as defined by the British Association of Teachers of the Deaf (BATOD) descriptors.

‘Child’ or ‘children’ refers to any baby, child or young person.

Throughout the text digital signal processing (DSP) hearing aids, cochlear implants (CI), bone anchored hearing aids (Baha®) and bone conduction hearing aids will be referred to as ‘hearing instruments’.

‘Parent’ or ‘family’ is used to denote the carer with legal responsibility for the child.

‘Teaching assistant (TA)’ is used throughout to describe a range of support staff working with deaf children. Titles used in local settings may vary.

The abbreviation ‘QS’ is used throughout to denote Quality Standards.

Acronyms and specialist terms are defined in the glossaries at the end of both this document and the *Good Practice Guide (GPG)*.

Introduction

Personal FM systems have the potential to greatly enhance the listening experience of deaf children by improving the audibility of speech in situations where distance, background noise and reverberation make listening difficult. To date there have been no UK guidelines relating to the provision, use and management of personal FM systems. This document is the first edition of Quality Standards and guidance for best practice in these areas. It has been prepared by the UK Children's FM Working Group which comprises representatives from manufacturers of FM systems, cochlear implants and hearing aids; the Modernising Children's Hearing Aid Services (MCHAS) team; national organisations; voluntary agencies and practitioners in education, audiology and cochlear implant services.

The document is aimed at those who commission services and at practitioners including paediatric audiologists, educational audiologists, teachers of deaf children and parents.

Its purpose is twofold:

1. To provide a framework with realistic and attainable quality standards against which health and education services can audit.
2. To describe good practices for the selection, fitting, management and evaluation of FM systems for children. Additional information and exemplars of practice and procedures in support of the recommendations are included in the *Good Practice Guide* CD or at www.ndcs.org.uk

Knowledge, practice and technology are evolving all the time. It is expected that there will be revisions and updates to this document on a three yearly basis to reflect these developments.

Context

It is currently the remit of local authorities (LA) or educational support services to provide, fit and manage FM systems, within the legislative framework of the four national governments of the UK. This includes the Disability Discrimination Act and Special Educational Needs or Additional Support for Learning legislation and accompanying codes of practice. The document also embraces the principles of integration of services, multi-agency working, accountability, health and safety and achievement within national governments' strategies for children such as *Getting It Right for Every Child* in Scotland, *Our Pledge* in Northern Ireland, *Children First* in Wales and *Every Child Matters* in England.

It is usually educational audiologists or teachers of deaf children who fit and manage FM systems. They work collaboratively with children, families and others including mainstream teachers, Teaching assistants (TAs), and technicians. The effective fitting of FM systems also requires the involvement of paediatric audiologists in hospitals and personnel in Cochlear Implant (CI) and Baha® centres, as the efficacy of the FM system depends on the individual hearing instruments being correctly fitted.



Equipment and training



The people coordinating the provision of FM systems should:

- have access to the necessary test equipment;
- possess up-to-date knowledge and skills to complete the procedures described in this document;
- adhere to published guidelines where appropriate;
- understand the legislative requirements relating to services and provision.

Communication

- It is essential that proper channels for communication are established between education and health specialists for the efficient exchange of information for the child's hearing care (MCHAS 2005).
- Information given to families must be unbiased, comprehensive, clear, accessible and accurate. Parents must receive all information in their preferred language and have equal access to their preferred forms of information. This could be written, verbal, video or audio tape. (NDCS 2003a; NDCS 2003b; Health and Social Services (HSS) Executive Northern Ireland 2002/3). Parents should also be able to ask questions as they arise.



Candidacy for receiving a personal FM system

To date there have been no agreed candidacy criteria for the provision of personal FM systems to children in the UK. Such systems are used effectively by people who wear hearing instruments: pre-school and school age children, students in higher education, and working adults. This document aims to encourage positive consideration of how provision of a personal FM system may facilitate listening and learning, rather than how a deaf child can contend with difficult listening environments in its absence. The listening environment in most schools is less than ideal and with an increase in the use of day care and nursery facilities, even very young children may be in hostile listening conditions. For this reason, young children as well as school age children can benefit from the use of personal FM systems (ASHA 1991, 2002).

The following key factors seek to provide a common approach to the timely and appropriate provision of FM systems.



QS1 Every child with a hearing loss should be considered as a potential candidate for provision with a personal FM system as part of their amplification package, in line with a written policy on candidacy. See also QS10 below.

This position requires that providers ask why a child with a hearing loss should not be considered as a potential candidate for a personal FM system, rather than which child should. It also points to the need for a close working relationship between health and education teams.

It should also be remembered that some children with normal hearing thresholds and therefore without hearing instruments (for example, those with auditory processing difficulties) may also benefit from the use of a personal FM system.

Essential factors in determining suitable candidacy include the following:

- Established, reliable use of hearing instruments; wherever possible this would include an appreciation of the effect of distance on sound, and localisation skills. Judicious use in certain contexts can offer benefit before listening skills are developed.
- Children with CIs have a stable map and can report on sound quality wherever possible.
- Appropriate support and training mechanisms to ensure those in the child's environment can support the use of FM technology.

Contexts for candidacy and other factors for consideration can be found in the *Good Practice Guide*. (See [GPG QS1](#))



QS2 There is an identified budget and clear accountability for funding personal FM systems where the candidacy criteria are met.

(See [GPG QS2 i](#))

- With the development of Children's Services, and rapid technological innovations such as hearing aids with integral FM receivers, funding from separate streams will eventually no longer be necessary.

Fitting and setting up of personal FM systems

The Quality Standards are centred on the recommended FM Advantage procedures developed by the MCHAS project and endorsed by the British Academy of Audiology (BAA).

There should be consultation between the professionals in health and education teams to ensure compatibility between the FM system and hearing instruments and their appropriateness in meeting the individual's needs. Practicalities that must be addressed before the system is set up include:

- selection of hearing instruments with direct audio input (DAI) facility;
- sharing detail of the hearing instrument: compression strategy; features activated;
- adapting the hearing instrument battery compartment where necessary;
- appropriate activation of FM/DAI feature within the hearing instrument software, (FM+M is recommended as the default start up programme for younger children).

QS3 The personal FM system must be set up with the child's individual hearing instruments to ensure that the FM signal received provides the desired advantage.

- All individual components of the system must be checked before setting up the system. *(See GPG QS3 i)*
- For hearing aids, follow FM Advantage guidelines. *(See GPG QS3 ii)*
- For bone conduction aids, electroacoustic fitting goals must be achieved. *(See GPG QS3 ii, iii)*
- Note the required FM receiver settings and retain a copy of the results for a baseline reference; send copies to other relevant professionals.

QS4 Initial fitting and setting up of a personal FM system with a cochlear implant speech processor must be carried out by an appropriately trained CI centre professional. This should take place at the implant centre.

Follow the CI/FM guidelines procedure. *(See GPG QS4 i, ii and iii)*



QS5 The child's listening response must be checked with the complete system in place.

- Check that speech is audible through the FM system both at close range and at a distance of 2-3 metres.
- Use close observation or an appropriate listening task to suit the developmental stage of the child. *(See GPG QS5 i)*
- Choose an appropriate task to establish the sound quality experienced by children unable to report this easily themselves. *(See GPG QS5 ii)*

QS6 Training and written information about the personal FM system, its settings and its appropriate use must be agreed and shared with the child, parents, teachers and all those involved in supporting the child.

- Ensure that skills in using the system and basic troubleshooting are taught to key participants as part of the fitting process and cascaded to others as soon as possible. This should be undertaken by a suitably qualified professional with day-to-day responsibility for the system.
- Review all the above when any change of hearing instrument or settings is made, or if part or whole of the personal FM system is repaired or replaced, or new personnel are involved.
- Information should include detailed practical instructions and be available in appropriate formats. *(See GPG QS6 i)*



Management and use of personal FM systems



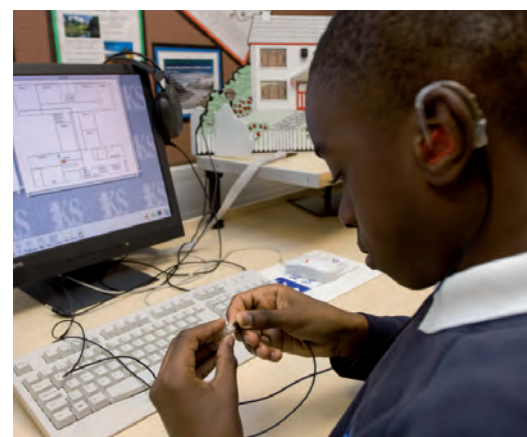
This section addresses important practical aspects of the daily management and use of personal FM systems that will allow users of all ages to gain the maximum benefit in a range of different situations.

There is a duty of care on those who provide children with personal FM systems to ensure as far as possible that this equipment is used appropriately and works effectively at all times. Appropriate ongoing training for all those involved is an important element of good management and use, as is routine testing and monitoring of the equipment. The successful management and use of the system depends on shared ownership and partnership between the child, parents and professionals and across agencies. There should be a designated person with day to day responsibility for this. *(See GPG QS6)*

The benefit of personal FM systems to deaf children is highly dependent on an understanding of correct use of the system. Its success is also dependent on sensitivity and positive attitudes of all those involved.

QS7 A programme for developing optimal use and management of personal FM systems should be agreed, recorded and reviewed at least annually.

- Offer ongoing training programmes for all those involved in the use of FM systems to match changes in the child's needs, equipment, personnel and the contexts for FM use. *(See GPG QS7 i)*
- Set targets for developing skills in the use and management of the equipment.
- Record the child's understanding and independence in use of the equipment. *(See GPG QS7 ii)*
- Using the FM system outside of the classroom should be encouraged. *(See GPG QS10 iii)*



QS8 Subjective checks of personal FM systems must take place regularly. (NDCS 2005b; MCHAS 2006)

- Listening checks of the FM system should be performed, with and without the hearing instrument, using appropriate devices such as a stetoclip, listening earphones, a Baha® listener, CI listening earphones or a dedicated headphone set for the FM system.

(See GPG QS5 and QS8)



QS9 Electroacoustic checks must be performed regularly and whenever a part of the system is changed. (NDCS 2000; Johnson 2007)

- The interpretation of 'regularly' is defined in the light of different contexts and more detail can be found in the *Good Practice Guide*. (See GPG QS 9 i)
- Regular checks are used in order to compare the frequency response curves with baseline settings provided at the time of set-up. (See GPG QS3 i, ii and QS4 i)



QS10 Clear identification of roles and responsibilities regarding the management of equipment should be in place.

- An accessible written policy should be in place detailing roles, responsibilities and procedures. (See GPG QS10 iii)
- Provision should be made within service policy to cover replacement, loan and upgrades of systems.
- Detailed records of equipment, settings and frequency response curves (FRC) should be kept for each child. (See GPG QS10 i)
- Clear routines and procedures for the maintenance of equipment should be in place. (See GPG QS10 ii)



Evaluation of personal FM systems for individual children

Evaluation is an important aspect of the fitting and ongoing management of personal FM systems. New recommended procedures have been developed specifically for these Quality Standards. A standardised, systematic approach to evaluation enables the benefits to individual children to be identified and compared. Good communication between health and education personnel and within Children's Services is an essential part of the evaluation process.

QS11 Subjective and objective evaluation of a personal FM system to determine its benefit must be carried out at least annually.



- Including objective and subjective measures is important for a comprehensive assessment. (See [GPG QS11 i](#)) Information from objective and subjective evaluation procedures should be collated and used to inform the joint preparation of an individual FM management plan.
- See [GPG QS11 ii](#) for examples of questionnaires to use in evaluation. These should be co-ordinated by the professional with day to day responsibility for the FM system. The views of the child (where possible) and other adults working with the child should be sought, including parents when the system is used at home.

- See [GPG QS11 iii](#) for details of the equipment needed for one speech in noise evaluation procedure.
- See [GPG QS11 iv](#) for details of a suggested procedure for one speech in noise evaluation.

QS12 There must be close liaison between health and education teams, including the exchange of written information, and joint training relating to the use of the child's personal FM system. (MCHAS 2005)

- Communication relates to all stages from candidacy through to evaluation.
- The need for change in the amplification package as the child matures will impact both health and education teams. Close liaison will ensure the child's FM system continues to be optimal. (See [GPG QS12 i](#))
- Joint training sessions provide the opportunity to share this information. They also serve to encourage closer liaison and an enhanced understanding of the various roles of staff within a comprehensive hearing aid fitting service (MCHAS 2005).

The use of personal FM systems with soundfield systems

Soundfield is an increasingly popular system designed to improve listening conditions for all children in the classroom. It aims to do this by providing a consistent level of sound from the primary source, usually the teacher, throughout the classroom at an approximate advantage of 10dB above the minimal background noise. It cannot provide the higher signal-to-noise ratio (SNR) that is required for deaf children and should not, therefore, be seen as an equivalent replacement for a personal FM system. (Ross, Levitt, 2002)

Most deaf children who wear hearing instruments continue to need the superior SNR provided by personal FM systems. (Crandell C, Smaldino J, Flexer C, 2004; BATOD magazine January 2001; Wood and Popplestone, 2005)

A soundfield system does not alleviate the difficult listening conditions created by high reverberation levels or excessive background noise. These issues should be addressed prior to soundfield systems being introduced by taking remedial action in accordance with guidelines such as *Building Bulletin BB93 – the Acoustic Design of Schools* (2003); *School Design: Optimising the Internal Environment* (March 2007) and *Building our Future: Scotland's School Estate* (March 2007).

QS13 Where soundfield systems are used in conjunction with personal FM systems, equipment must be selected and set up to ensure that the performance of the personal FM system is not compromised.

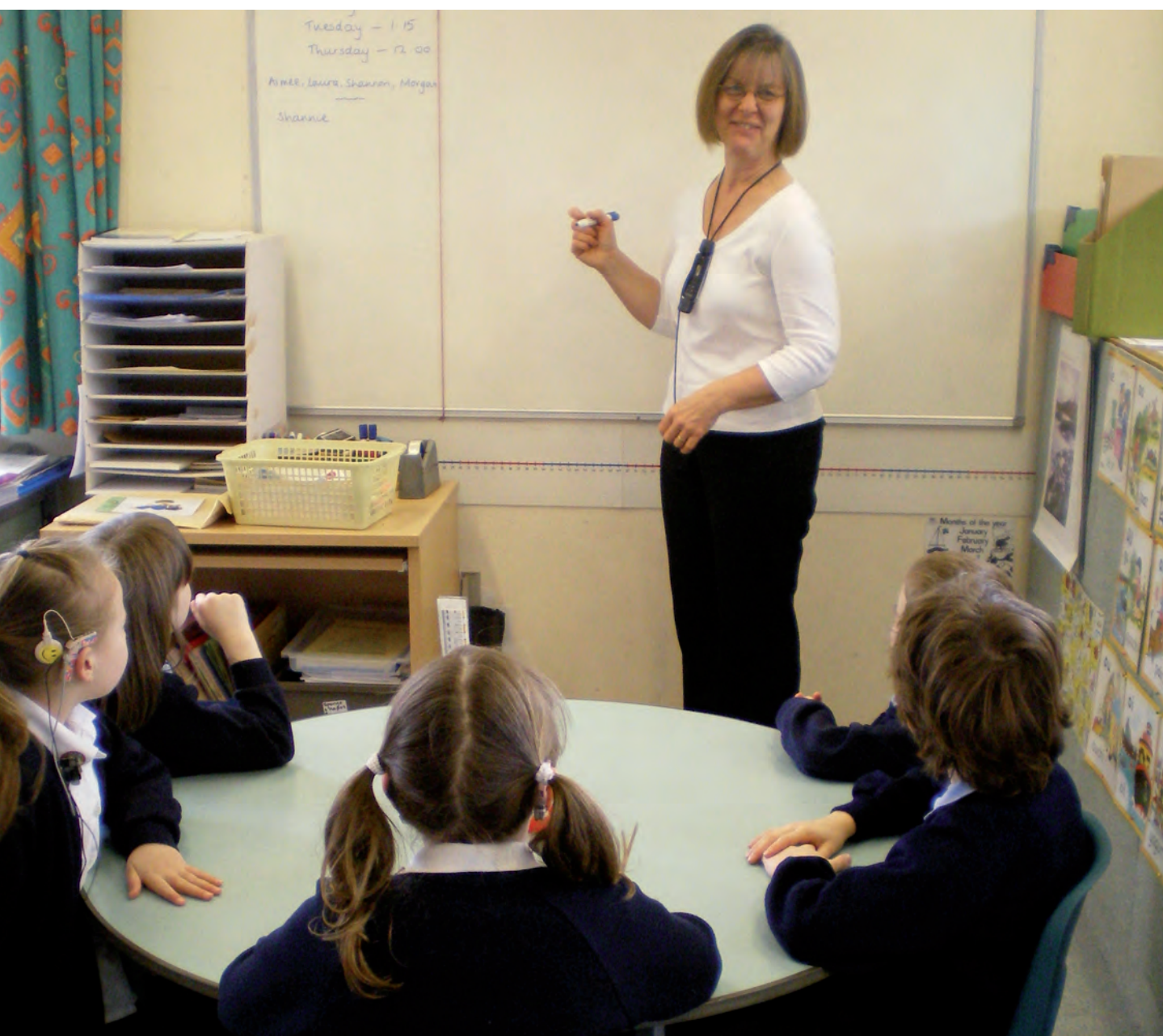
There can be a number of advantages for the deaf child when the personal FM system is combined with the soundfield system. (*See GPG QS13 i*)



Conclusion

Many people from pre-school children to adults effectively use personal FM systems to improve their listening experience in hostile acoustic environments. These systems must be appropriately fitted, and used and managed consistently. This can best be achieved through close liaison between health and education personnel. Joint training sessions provide the opportunity to update skills, to share information, and to explore how the collaborative links can work at their most coherent and productive. Our hope is that these Quality Standards will encourage further development and support good practice. Our ultimate goal is for every deaf child to have the best possible access to communication, learning and social interaction.

Further detail about each Quality Standard can be found in the complementary *Good Practice Guide* (see the CD on the inside front cover of the printed edition of this document or www.ndcs.org.uk).



References

American Academy of Audiology (2008) *Clinical Practice Guidelines: Remote Microphone Hearing Assistance Technologies for Children and Youth (Birth to 21 Years)*. www.audiology.org/publications/documents/positions/

American Speech-Language-Hearing Association (ASHA) (1991) *The use of FM amplification instruments for infants and pre-school children with hearing impairment*, **ASHA Suppl. Mar;(5):1-2**.

American Speech-Language-Hearing Association (ASHA) (2002) *Guidelines for fitting and monitoring FM systems*. ASHA Desk Reference.

Anderson, K.L. (2002) *ELF-Early Listening Function, discovery tool for parents and caregivers of infants and toddlers*.

Available from: www.phonak.co.uk/ccuk/professional/pediatrics/diagnostic.htm

Anderson, K.L. and Smaldino, J.J. (1997) 'The Listening Inventories For Education (LIFE): a classroom measurement tool', *The Hearing Journal* 52 (10): 74-76.

Available from: www.hear2learn.com

Anderson, K.L. and Smaldino, J.J (2000) *Children's Home Inventory for Listening Difficulties (CHILD)*

Available from www.phonak.co.uk/ccuk/professional/pediatrics/diagnostic.htm

Bamford J., Skipp A., Hostler M., Davis A., Barton G. and Sithole J., (2004) *Report on first wave studies (Modernisation of NHS Hearing Aid Services: Paediatric Arm)*, Manchester University.

Bamford, J. (2003) *Modernising Children's Hearing Aid Services: provision of FM (radio aid) systems - Briefing paper to the Children and Young Persons Advisory Group (CYPAG)*, Manchester University.

British Association of Teachers of the Deaf (BATOD) (2006) *Audiometric descriptors* www.batod.org.uk/index.php?id=/articles/audiology/audiometric-descriptors.pdf

British Association of Teachers of the Deaf (BATOD) (2001) *Classroom Acoustics – recommended standards*

Available from www.batod.org.uk/index.php?id=/articles/audiology/magazine/classroom-acoustics.htm

Boothroyd, A. (2003) 'Room acoustics and speech reception: a model and some Implications' in Fabry, D., and DeConde Johnson, C. (Eds) *ACCESS: Achieving Clear Communication Employing Sound Solutions*, Proceedings of the First International FM Conference, pp. 207-216, Phonak.

Available from www.phonak.com/professional/informationpool/proceedings.htm

Ching, T.Y.C. (2007) *The Parents' Evaluation of Aural/Oral Performance of Children (PEACH)* from www.nal.gov.au

Ching, T.Y.C. and Hill, M. (2007) 'The Parents' Evaluation of Aural/Oral Performance of Children (PEACH) Scale: normative data', *Journal of the American Academy of Audiology*, Mar;18(3):220-235.

Crandell, C., Smaldino, J. and Flexer, C. (2004) *Soundfield Amplification: Applications to speech perception and classroom acoustics* (2nd edition), Clifton Park, New York, Thompson Delmar Learning.

Dillon, H., James, A. and Ginis, J. (1997) 'Client Oriented Scale of Improvement (COSI) and its Relationship to Several Measures of Benefit and Satisfaction Provided by Hearing Aids', *Journal of the American Academy of Audiology* Feb;8(1):27-43.

Dockrell, J., and Shield, B. (2006) 'Acoustical Barriers in classrooms - the impact of noise on performance in the classroom', *British Educational Research Journal* vol 32, no. 3, pp 509-525.

English, K. (2003) 'FM counselling issues: adolescents and young adults, or the case of Jason B', in Fabry, D. and DeConde Johnson, C. (Eds) *ACCESS: Achieving Clear Communication Employing Sound Solutions*, Proceedings of the First International FM Conference, pp. 179-183, Phonak.
Available from www.phonak.com/professional/informationpool/proceedings.htm

Evans, D. (2002) *FM Advantage: procedure for the setting up of FM radio systems for use with hearing aids*.
Available from www.connevens.com/information/fkadventure.pdf

Gabbard, S.A. (2003) 'The Use of FM Technology for Infants and Young Children' in Fabry, D. and DeConde Johnson, C. (Eds) *ACCESS: Achieving Clear Communication Employing Sound Solutions*, Proceedings of the First International FM Conference, pp. 93-99, Phonak.
Available from www.phonak.com/professional/informationpool/proceedings.htm

Green, R. (1997) 'The Uses and Misuses of Speech Audiometry in Rehabilitation' in Martin, M. *Speech Audiometry*, London, Whurr.

Grimshaw, S. (1998) *Listening Situations Questionnaire* (Unpublished PhD thesis, Nottingham, UK)
Available from www.psychsci.manchester.ac.uk/mchas/eval/quest

Hine, J. and Vaughan, R. (2004) *Report on survey of LEA criteria for the provision of FM systems*, UK Children's FM Working Group.
Available from www.psych-sci.manchester.ac.uk/mchas/fm/

Hostler, M. (2004) 'Fitting FM Systems with Advanced Digital Signal Processing Hearing Aids' in Fabry, D. and DeConde Johnson, C. (Eds) *ACCESS: Achieving Clear Communication Employing Sound Solutions*, Proceedings of the First International FM Conference, pp. 155-166, Phonak.
Available from www.phonak.com/professional/informationpool/proceedings.htm

Ling, D. (1989) *Foundations of Spoken Language for the Hearing Impaired Child*, Washington DC, AG Bell Association for the Deaf.

Martin, M. (1997) *Speech Audiometry*, (2nd edition), London, Whurr.

Modernising Children's Hearing Aid Services (MCHAS) (2005) *Guidelines for Professional Links between Audiology and Education Services within a Children's Hearing Aid Service*

Available from www.psych-sci.manchester.ac.uk/mchas/guidelines/

Modernising Children's Hearing Aid Services (MCHAS) (2005)

www.psych-sci.manchester.ac.uk/mchas/

National Deaf Children's Society (NDCS) (2000) *Quality Standards in Paediatric Audiology: Volume IV*, London

Available from www.ndcs.org.uk/paediatricaudiology

National Deaf Children's Society (NDCS) (2003a) *Deaf Children: Positive Practice in Social Services*, London Available from www.ndcs.org.uk/positivepractice

National Deaf Children's Society (NDCS) (2003b) *Quality Standards in the Early Years: Guidelines on working with deaf children under two and their families*, London

Available from www.ndcs.org.uk/qsearlyyearsengland

www.ndcs.org.uk/qsearlyyearswales

www.ndcs.org.uk/qsearlyyearsscotland

www.ndcs.org.uk/qsearlyyearsni

National Deaf Children's Society (NDCS) (2005a) *Quality Standards and Good Practice Guidelines: Cochlear Implants for Children and Young People*, London

Available from www.ndcs.org.uk/qscochlearimplants

National Deaf Children's Society (NDCS) (2005b) *Radio Aids, an Introductory Guide*, London Available from www.ndcs.org.uk/radioaids

Ousey, J., Sheppard, S., Twomey, T. and Palmer, A.R. (1989) 'The IHR/McCormick automated toy discrimination test - description and initial evaluation', *British Journal of Audiology* Aug;23(3):245-249.

Pither, R. (2004) *Getting It Right* (video/DVD), London, Ewing Foundation, Available from www.ewing-foundation.org.uk

Rosenberg, G., Blake-Rahter, P., Heavner, J., Allen, L., Redmond, B. and Phillips, J. (1999) 'Improving Classroom Acoustics (ICA): A Three-year FM Soundfield Classroom Amplification Study', *Journal of Educational Audiology*, vol. 7, pp. 8-28.

Ross, M. and Levitt, H. (2002) 'Developments in Research and Technology; Hearing Assistive Technologies; Classroom Soundfield Systems', *Volta Voices*, vol. 9, pp. 7-8.

Schafer, E.C. and Thibodeau, L.M. (2006) 'Speech Recognition in Noise in Children With Cochlear Implants while Listening in Bilateral, Bimodal and FM-System Arrangements', *American Journal of Audiology*, vol. 15, pp. 114-126.

Smiley, D., Martin, P.F. and Lance, D.M. (2004) *Using the Ling 6 Sound Test Every Day* Available from www.audiologyonline.com/articles

South of England Cochlear Implant Centre (SOECIC) (2007) *Guide for using an FM system with a Cochlear Implant*

Whitelaw, G.M., Williams, C. and Wynne, M.K. (2001) *Children's Outcome Worksheets (COW): Validation and Efficacy*, 13th Annual Convention of the Academy of Audiology, San Diego.

Available from

[www.otikids.com/eprise/main/Oticon/com/SEC_Professionals/ProductInformation/Sumo/SumoDM/Kids/Child-focusedSoftware/ CNT05_Counselling](http://www.otikids.com/eprise/main/Oticon/com/SEC_Professionals/ProductInformation/Sumo/SumoDM/Kids/Child-focusedSoftware/CNT05_Counselling)

Wood, E. (2008) 'Getting the systems right', *BATOD magazine*, January 2008, pp. 19-21.

Wood, E. and Popplestone, J. (2005) 'Successful Use of FM Systems with Cochlear Implant Speech Processors', *BATOD magazine*, March 2005, pp. 14-16.

Further information

Fitting guides and other useful information can be found at:

www.advancedbionics.com • www.bioacoustics.com
www.boystownhospital.org/hearing/hearingaids/fmsystems.asp • www.cochlear.co.uk
www.connevans.com • www.earfoundation.org • www.larci.org.uk • www.medel.com
www.oticon.com www.pcwerth.com • www.phonak.com • www.soecic.org.uk
www.widex.com

Key Government publications

Building Bulletin BB93 DfES, the Acoustic Design of Schools (2003)
www.dfes.gov.uk

School Design: Optimising the Internal Environment (March 2007)
www.scotland.gov.uk/publications

Building our Future: Scotland's School Estate (March 2007)
www.scotland.gov.uk/publications

Children Act (2004) Elizabeth II – Chapter 31 (Parliament) available from TSO (The Stationery Office) www.tso.co.uk/bookshop

Disability Discrimination Act (2005) Elizabeth II – Chapter 13 (Parliament) available from TSO (The Stationery Office) www.tso.co.uk/bookshop

Every Child Matters available from TSO (The Stationery Office)
www.tso.co.uk/bookshop

Additional Support for Learning Act (2004) Scottish Executive

Getting It Right for Every Child (2005) Scottish Executive
www.scotland.gov.uk/Topics/People/youngPeople/childrenservices/girfec

Supporting Children's Learning Code of Practice (2005) Scottish Executive

SEN Code of Practice – Wales (2004) Welsh Assembly Government

Children First (2005) Welsh Assembly Government
www.wales.gov.uk/topics/childrenyoungpeople/childrenfirst/?lang=en

Charter Standards for Services for Children and Young People, HSS Executive (NI), (2002, 2003) www.dhsspsni.gov.uk/dhssps_sda09_04_02.pdf

Our Children and Young People – Our Pledge (2006) Office of the First Minister and Deputy First Minister for Northern Ireland

Code of Practice on the Identification and Assessment of SEN (1998) Department of Education, Northern Ireland

Supplement to the Code of Practice on the Identification and Assessment of SEN (2005) Department of Education, Northern Ireland

Resources available from the Ewing Foundation

www.ewing-foundation.org.uk

Ewing Foundation (2007) *Classroom Babble* (CD) Ewing Foundation, London

Getting It Right (video/DVD) Ewing Foundation, London

Contact: Graham Hamilton, Ewing Foundation, HCD, School of Education,
University of Manchester, Oxford Road, Manchester M13 9PL

Email: grahamh@ewing-foundation.org.uk

Resources available from NDCS

www.ndcs.org.uk

Loan equipment available from NDCS Blue Peter Loan Scheme.

Acoustics Toolkit – a toolkit to help schools improve acoustic conditions for deaf children (2007)

Radio Aids – an introductory guide (2008)

Understanding Deafness (2007)

Contact the NDCS Freephone Helpline for our full publications list, details of our equipment loan scheme and the services listed on the inside back cover of this publication.

Other resources

Somerset picture tests jgardiner1@somerset.gov.uk

Parrot (MTT, MPT, MJW, AB lists) Soundbyte solutions: www.soundbytesolutions.co.uk

Classroom Acoustics course www.maryhare.org.uk

Glossary of Terms

Some of the terms below have multiple meanings. The definitions given relate to the context of this document.

Amplification package	Personal hearing aids ie hearing aid, cochlear implant or Baha® and assistive devices
Assistive devices	Equipment used in addition to personal hearing instruments eg personal FM systems, audio adaptors
Audio adaptors for cochlear implant speech processor	A lead or an adaptor to connect a personal FM system cable to a CI speech processor
Audio output socket	A socket on a soundfield amplifier that allows connection to a personal FM system transmitter. The term can also be used to describe a socket on a bodyworn personal FM receiver which allows leads to be connected to the hearing aids
Auditory processing difficulties/disorder (APD)	Difficulty in processing auditory information in the cortex; sufferers do not usually have a hearing loss when assessed using traditional tests
Auxiliary audio input socket	A socket on a transmitter that allows connection of an external audio source (computer or whiteboard etc) directly to that transmitter
Azimuth	The angle at which a loudspeaker is placed in relation to a point in front of the person being tested
British Academy of Audiology (BAA)	The professional association for audiologists, audiological scientists and hearing therapists
British Association of Teachers of the Deaf (BATOD)	The professional association for teachers of deaf children in the UK
Babble/compressed babble/pink noise	Forms of noise used to replicate a more realistic listening environment in which to carry out speech testing
Bone conduction	The transmission of sound to the inner ear by means of mechanical vibration of the cranial bones
Bone anchored hearing aid (Baha®)	A type of bone-conduction hearing aid that clips onto an abutment that has been surgically implanted into the skull
Bone conduction hearing instrument	A hearing instrument with a vibrating output produced by a transducer held against the skull with a sprung metal or elasticated headband or spectacle arm
Cochlear implant (CI)	A device implanted under the skin that picks up sounds from an externally worn processor and then converts them to small electrical impulses transmitted to electrodes placed in the cochlea, restoring some hearing to people with a profound hearing loss
Conference microphone	A microphone used in a group situation to pick up the voices of a number of speakers, often placed at the centre of a table
Coupling	The process of connecting a personal FM system to a hearing instrument with or without wires

Direct audio input shoe (DAI)	A coupling device to join a hearing aid to other audio equipment (see 'shoe')
Dual channel (or multi-channel)	The ability for FM systems to work on more than one frequency; used when more than one FM user is in the same setting. May also refer to a specific receiver that will alternate between two transmission frequencies
Electroacoustic testing	Testing of equipment using a hearing aid analyser (test box)
Environmental microphone	A microphone in or on the receiver of a personal FM system picking up local sounds
FM Advantage	A recognised procedure for setting up FM systems to give priority to the signal coming through the transmitter microphone
Frequency	The radio channel on which a personal FM system is transmitting and receiving
Frequency response	One standard of measuring the performance of a hearing instrument or personal FM system ie how an aid responds to varying sounds
Frequency response curve (FRC)	Graphical representation of a frequency response
Individual education plan (IEP)	A personalised programme of learning that is different from or additional to normal differentiation of the curriculum, setting achievable targets
Integral system	A combined ear level hearing instrument and personal FM system within the same housing
Learning support assistant (LSA)	Educational support staff working with children under the direction of class teachers and teachers of the deaf
Linear processing	Amplification which delivers the same amount of gain for varying levels of input
Mapping	The process of optimally defining the detail of electrical stimulation levels and selecting the speech processing strategy for a cochlear implant
Mixing ratio	The ratio of sound picked up through the cochlear implant speech processor microphone to the sound received through the personal FM system
Muting switch (mic mute)	A switch which deactivates the microphone on the transmitter without turning off the system
Non-linear processing, also known as wide dynamic range compression (WDRC)	Amplification which gives variable gain for a range of inputs
Objective check	A quantitative way to ensure equipment is working eg using test box measures
Omnidirectional microphone	A microphone that picks up sounds from all directions

Personal amplification	A means of improving an individual's access to sound through, for example, a hearing aid, cochlear implant speech processor or Baha®
Personal FM system	A transmitter worn by the speaker and a receiver worn by the hearing instrument wearer
Psychometric parameters	Aspects such as validity, reliability and sensitivity of a measure
Radio aid	Another name for a personal FM system
Receiver (Rx)	The part of the personal FM system used by the hearing instrument wearer
Remote control	A device which allows settings on a hearing instrument to be adjusted remotely: it can be used to turn the device on/off, adjust volume or change programmes
Reverberation time	The time it takes an impulse sound to decay by 60 dB
Sensitivity control	This control on a cochlear implant speech processor affects the microphone's pick up range. The optimum setting is usually advised by the cochlear implant centre professional
Shoe	Allows a direct audio input (DAI) lead to be connected to a hearing instrument; there are many types, usually specific to one model. Some shoes include a built-in attenuator that reduces the level of the signal received
Signal to noise ratio (SNR)	A measurement of the level of a desired sound in relation to unwanted sound
Soundfield system	An amplification system which provides an even spread of sound around a room when used with multiple loudspeakers; a desktop version with one loudspeaker, called a personal soundfield system, is also available
Sound pressure level (SPL)	A measurement of sound intensity in decibels, measured in a test box or on a sound level meter
Sound level meter	An instrument used to measure sound pressure levels
Speech tests	A range of assessments used to determine ability to discriminate speech sounds/words/sentences
Speech in noise evaluation	Assessment of speech recognition performance in background noise
Stetoclip	A checking device for listening to hearing instruments or personal FM systems
Subjective check	Visual and listening test of equipment with a stetoclip, other listening device or by the user; also known as a 'psychoacoustic' check
Test box/hearing aid analyser	Test equipment used to evaluate the electroacoustic performance of a hearing instrument and for the setting up of a personal FM system
Tie-clip mic	A microphone that can be clipped to a lapel or other clothing
Transmitter (Tx)	Part of a personal FM system worn by the speaker

Notes

NDCS provides the following services through our membership scheme. Registration is simple, fast and free to parents and carers of deaf children and professionals working with them. Contact the Freephone Helpline (see below) or register through www.ndcs.org.uk

- A Freephone Helpline 0808 800 8880 (voice and text) offering clear, balanced information on many issues relating to childhood deafness, including schooling and communication options.
- A range of publications for parents and professionals on areas such as audiology, parenting and financial support.
- A website at www.ndcs.org.uk with regularly updated information on all aspects of childhood deafness and access to all NDCS publications.
- A team of family officers who provide information and local support for families of deaf children across the UK.
- Advice on special educational needs (SEN) disability discrimination in education and welfare benefits.
- Representation at SEN and Social Security Appeals Tribunals from our Legal Casework Service.
- An audiologist and technology team to provide information about deafness and equipment that may help deaf children.
- A children's equipment grants scheme and the opportunity to borrow equipment to try out at home.
- Family weekends and special events for families of deaf children.
- Sports, arts and outdoor activities for deaf children and young people.
- A quarterly magazine and regular email updates.
- An online forum for parents and carers to share their experiences, at www.ndcs.org.uk/parentplace.

NDCS is the national charity dedicated to creating a world without barriers for deaf children and young people.

NDCS Freephone Helpline:

0808 800 8880 (voice and text)

Open Monday to Friday, 10am to 5pm

Email: helpline@ndcs.org.uk

www.ndcs.org.uk